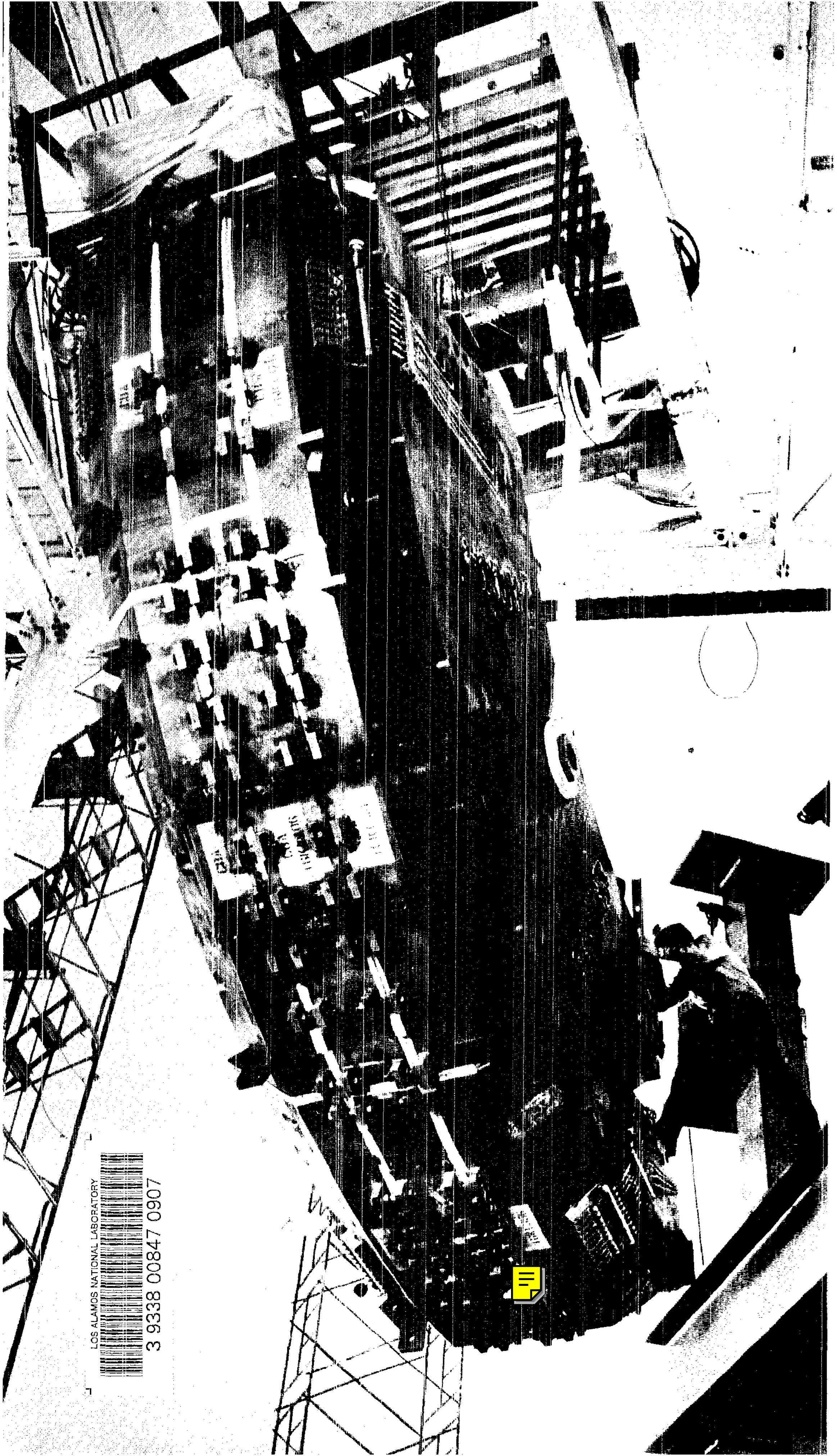

SUPERMAGNET: on the way up

the Atom

Los Alamos
Scientific Laboratory

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In this Issue

Regular Features

Editor
Jack Nelson

Photography
Bill Jack Rodgers, Johnnie Martinez, Henry Ortega, Matt O'Keefe.

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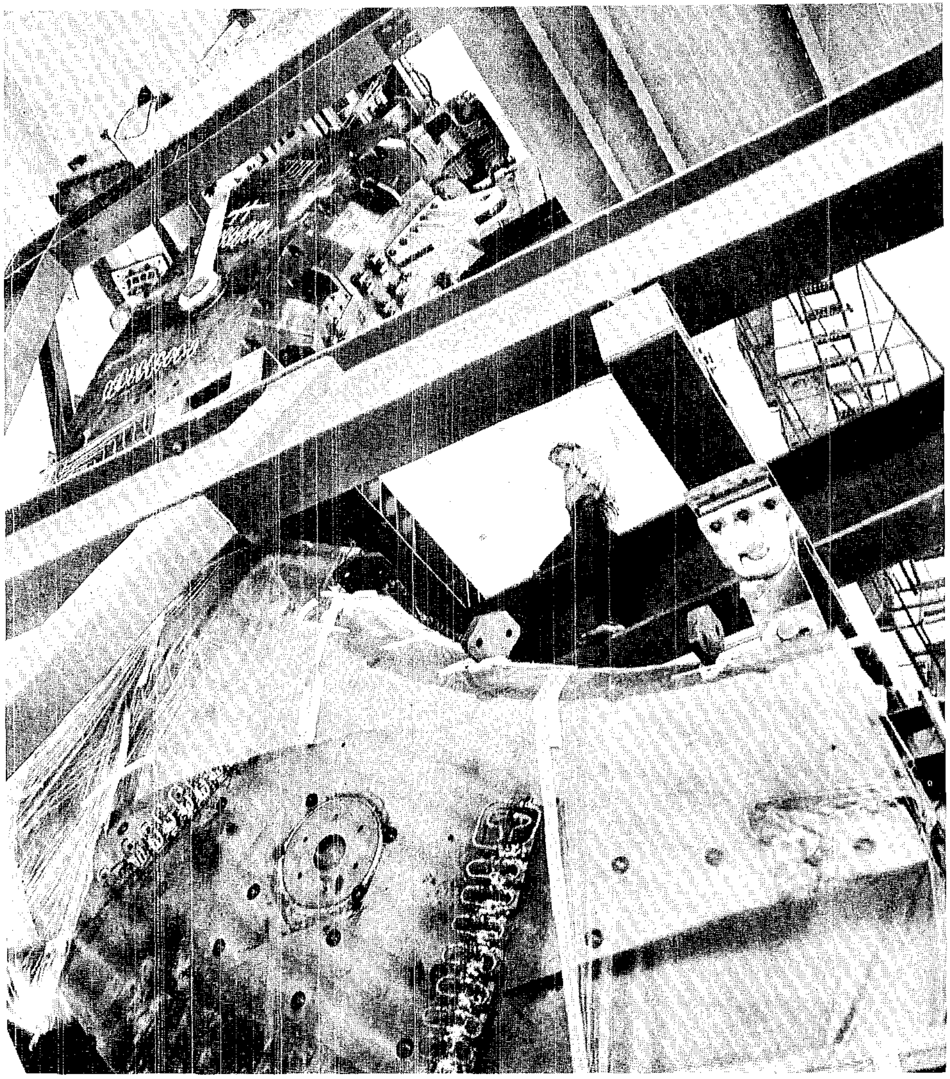
Cover

by Bill Jack Rodgers

A paradox of modern physics is that the closer you want to look, the bigger and more elaborate your instrument must be. LASL researchers and LAMPF users want to look very close—closer than anyone has looked before—at the nuclei of atoms themselves.

To do this, LASL scientists and engineers designed what may be the most sensitive spectrometer in the world, and one which is capable of very high resolution. Achieving this resolution requires huge magnets capable of producing extremely uniform fields.

In December, and after years of difficult work, the magnets were completed. There to document their being lifted to their final "home" in a frame at Experimental Area C at LAMPF was Bill Jack Rodgers, ISD-1. If all goes as planned, one of the world's extraordinary instruments will be in operation by this summer.



SUPER MAGNETS FOR A SUPER SPECTROSCOPE

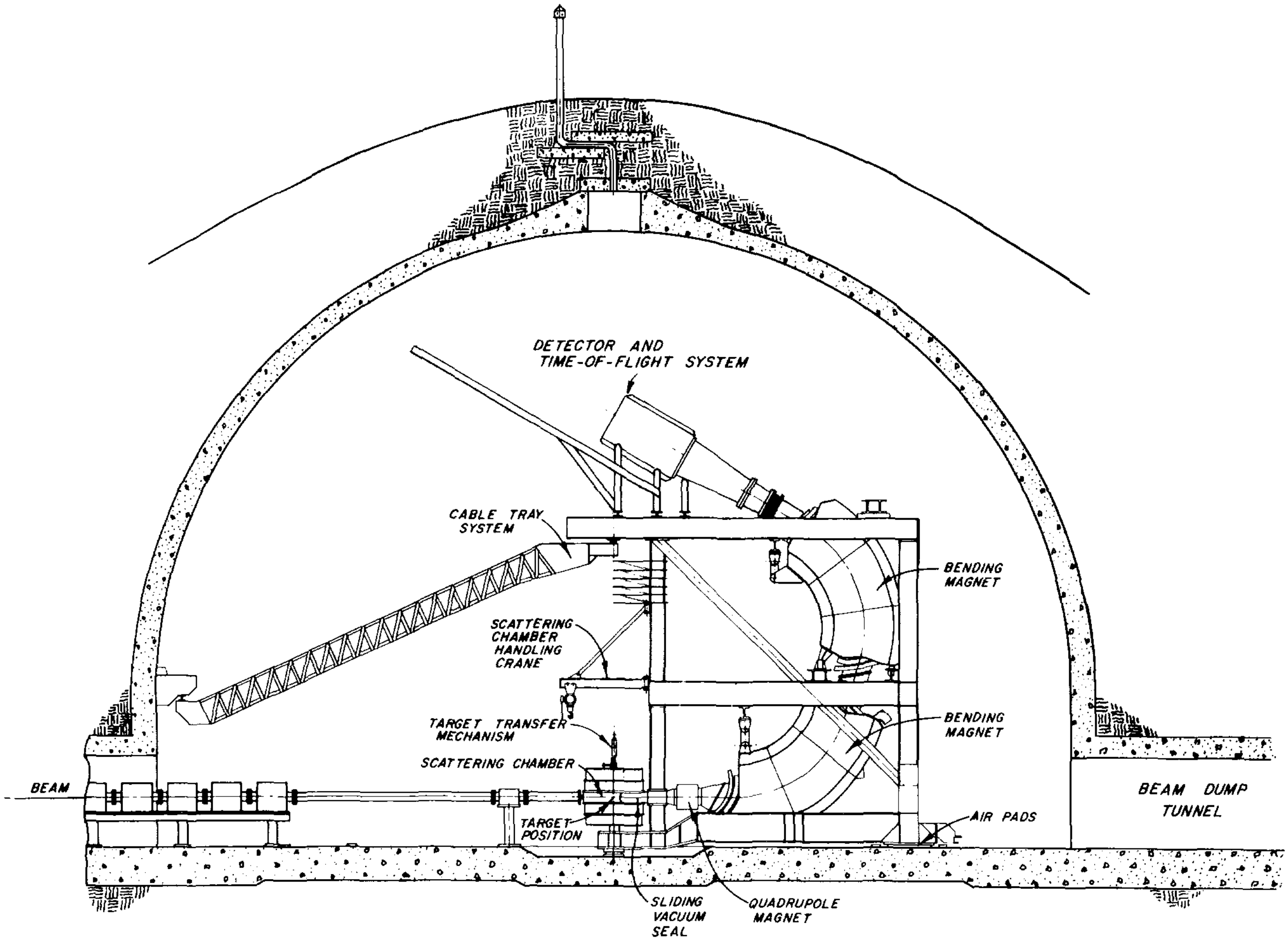
Inch by painful inch, the huge mass suspended by 8 2-inch square rods and hoisted by powerful hydraulic jacks moved toward the mosque-like ceiling. It was one of the world's largest magnets; its 135 tons of steel could make more than 60 American standard cars.

For all its awesome weight, its parts had been machined and hand-finished to diamond-like precision. The magnet was destined to become part of one of the world's most sensitive instruments—the high resolution spectrometer (HRS).

It is axiomatic in designing and building extraordinary instruments, such as the 200-inch telescope on Mount Palomar, that the greater the sensitivity and resolution required, the larger the dimensions and the greater the complexity and delicacy of the apparatus. Like the Mount Palomar telescope, the HRS is designed to see worlds never seen before. But unlike a telescope, the HRS is intended to probe secrets not of worlds without, but of worlds within. So great will be its resolving power that Los Alamos Scientific Laboratory investigators expect to "see" the shape of the atomic nucleus for the first time.

On Thursday, December 18, riggers of Southwestern Industrial Contractors and Riggers, Inc., headed by Gabe Mayr and working with a LASL engineering team headed by Lloyd Wilkerson, WX-4, rolled the magnet from its side to its back in Experimental Area C at the Clinton P. Anderson Los Alamos Meson Physics Facility (LAMPF). Two more days of preparation followed as the magnet was attached to the rods suspended from the hydraulic system, which was at the top of a temporary steel tower erected for the lifting operation.

Finally, on Tuesday, December 23, the painstaking ascent began. The riggers, anxious to complete the job so that they could return to



How LASL's new High Resolution Spectrometer works: a proton beam, left, enters the scattering chamber, center, from which scattered and produced particles are channeled by giant bending magnets, right, to the detector at the top of the frame.

their homes in time for the holidays, worked late into the night to raise the magnet, then lower it to its final resting place in a permanent steel frame designed to pivot about the center of the dome.

After the holidays, the riggers returned to perform the same brute-strength, but very touchy, operation with the second magnet, identical to the first, but mounted above it. Together, the permanent rack, weighing 67 tons, and the 2 magnets weigh 337 tons.

Presently, work is under way on the installation of other components: a scattering chamber at the pivot point of the frame at beam level, a detector and time-of-flight system on top of the frame, a water-cooling system to keep the powerful magnets from melting from their own heat, a high-vacuum system so that particles may reach their destination unaffected by air molecules, and a multitude of electronics and computer hardware to control the instrument and collect data from it.

If things proceed on schedule, testing and calibration will be accomplished this spring and the HRS should be ready this summer for experiments by LAMPF users from around the world.

We Are All Scatter-Brained

Scattering is fundamental to modern physics. It is the physicist's most useful and most used research tool. Not only does scattering allow the investigator to "see" very small objects and events associated with them, but it is the process by which we ourselves see most objects in everyday life.

When photons of light strike an object, some are absorbed and others are scattered. If the object is transparent or translucent, some photons pass through the material without being scattered, others are scattered forward through the material—in everyday life we call this refraction or diffusion. If the object is opaque, photons that are not absorbed may be scattered at various angles—we call it reflection. In a few cases, photons interact with the substance itself, causing that substance to release photons of its own—we call it fluorescence.

Regardless of how photons are scattered, a small fraction of them enter our eyes and strike the sensors (rods and cones) of our retinas. Individual nerves, gathered in a harness called the optic nerve, convey signals from them to our brain. There our visual "computer centers" translate the signals into something our brains can interpret in terms of brightness, form, and color. Seeing is accomplished ultimately in our minds, which have rather miraculously taken advantage of the effects of scattering.

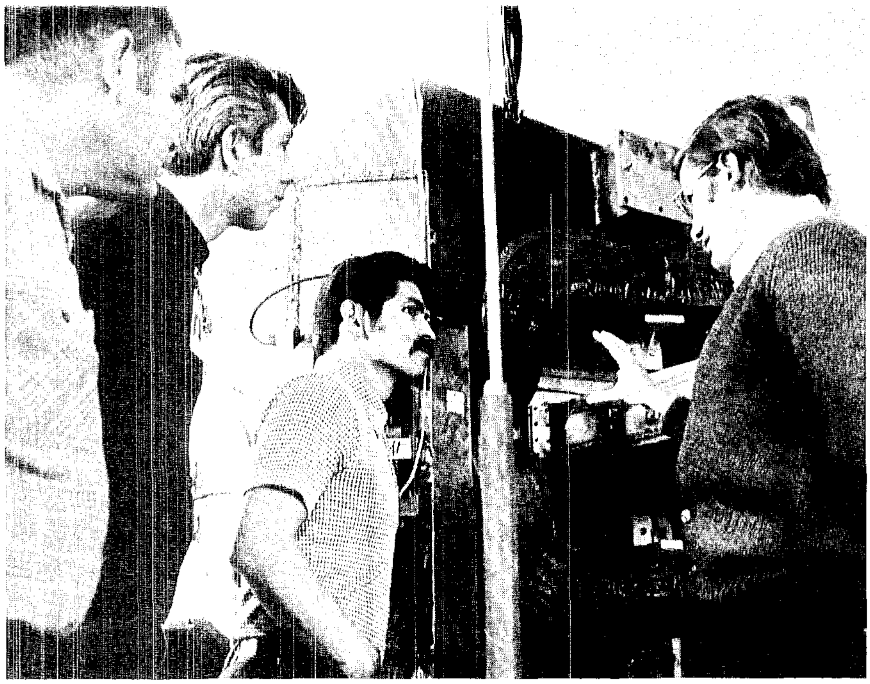
The analogy, if not perfect, in general describes the principle by which a spectrometer works. For the HRS, rather than a beam of photons, a beam of protons, diverted from LAMPF's main beam, is used. The protons strike a target, typically a film or thin foil of an element in a vacuum container called a scattering chamber. Some protons are scattered by the forces they encounter from atomic nuclei, while others produce completely new particles in the process. A small fraction of the scattered and newly produced particles will enter a vacuum channel within the magnets where their paths will be bent by the magnets' field so that the particles will arc up and back toward the instrument's "retina" at the top of the spectrometer.

During their flight, some particles will arc toward the outside of the channel because of their greater momentum (the product of their mass and velocity). Others, with less momentum, will swing towards an inside track. At the detection chamber, the particles will have separated into distinct bands or lines, forming a spectrum (hence the name "spectrometer").

In the HRS, the ability to resolve these different bands will be so great that what would appear to be a single line in a lesser spectrometer will appear as several distinct lines—hence the term "high resolution." And it is this substantially higher resolution that is expected to lead to the unearthing of information never discerned before.

At the end of their flight through the magnets, particles will register their passage in the detection system at the top of the frame in terms of their position, velocity, and generic type. From these measurements, transmitted via an "optic nerve" to computers, scientists can deduce a

Above, Wendell Smith, SD-5, and Nobuyuki Tanaka, MP-10, measure the finish on a bending-magnet polepiece to thousandths of a millimeter. A plastic-enclosed "greenhouse" was built to isolate the polepiece from dust during the delicate handfinishing operation. Below, machinists Ray McCormick, Dave Trimmer, and Joe Arellano, all SD-1, discuss intricacies of contouring a magnet nosepiece with Jim Spencer, MP-10.



great many facts, including the characteristics of the nuclei that caused the scattering in the first place.

The elaborate vertical design was chosen because it allows the HRS to swing through a much wider range than can a horizontal spectrometer. ("All spectrometers would be vertical rather than horizontal if space and money permitted," says Jim Spencer, MP-10.) It rotates on a cushion of air on rails at radii of 8 and 10 meters, pivoting on a giant spherical thrust bearing at the center of the dome. The ability to swing the spectrometer to either the right or left of the beam is required. When a polarized beam is used, spin, a characteristic of particles, will cause particles to scatter differently right and left.

In an apt analogy of his own, Spencer explains why LAMPF's proton beam is so well suited to "looking" at atomic nuclei. In the nether world of atomic physics where particles behave like waves, protons also have frequency. The frequency of visible light is much too low (and thus the wave much too long) to "see" atomic nuclei. It is as if one tried to analyze the characteristics of a cork in the ocean from its effects upon the patterns of long ocean swells. However, put the cork in a bowl and generate tiny waves and much could be learned by studying the pattern of waves deflecting around it; the frequency would be appropriate to the size of the target. The frequency of a particle is dependent upon the energy imparted to it; at 800 MeV, the energy of the LAMPF beam, the frequency of the proton becomes high enough (and the wave short enough) to be superbly matched to its nucleonic targets.

However, protons will not be the only particles used with the HRS. Pions and kaons, short-lived and engimatic particles, will be produced and studied in certain experiments, while deuterons, tritons, alpha particles, and other long-lived particles will be produced in others.

From the inception of LAMPF, it was recognized that a High Resolution Spectrometer would be the perfect mate for LAMPF's high-intensity proton beam; indeed, without such a grandly conceived instrument, the beam would never achieve its full research potential. Thus, the domed amphitheater, whose roof is now covered with 10 to 12 feet of soil as shielding against particles that go astray, was built as an integral part of the whole facility.

Building the extraordinary instrument itself, it was also recognized, would take some time, money (about $1¼ million), and doing. Many groups contributed to the design and construction, with specialized tasks for the magnetic and mechanical design being assigned to the University of California at Berkeley.

Shepherding the project as far as the physics and design of the HRS were concerned were Spencer and Henry Theissen, MP-10 group leader. Among their early decisions was one to use conventional rather than superconducting magnets. While the energies would be at the upper limit that conventional magnets could handle, they were nevertheless manageable. Taking the superconducting "route" would have entailed additional time and money with less certainty as to the outcome.

Participating in the setting of performance specifications from the outset was the LAMPF Users Group. More than 6 years ago, a committee negotiated these specifications with Louis Rosen, MP-Division leader. Later some of the components were fabricated at user laboratories around the country.

And users worked shoulder to shoulder with LASL personnel. Tom Kozlowski, Brookhaven National Laboratory, Philip Varghese, University of Oregon, and David Madland, formerly University of Minnesota (now T-2), worked around-the-clock with Nobuyuki Tanaka, MP-10, making flux-field and physical measurements vital to pinpointing problems and finding solutions.

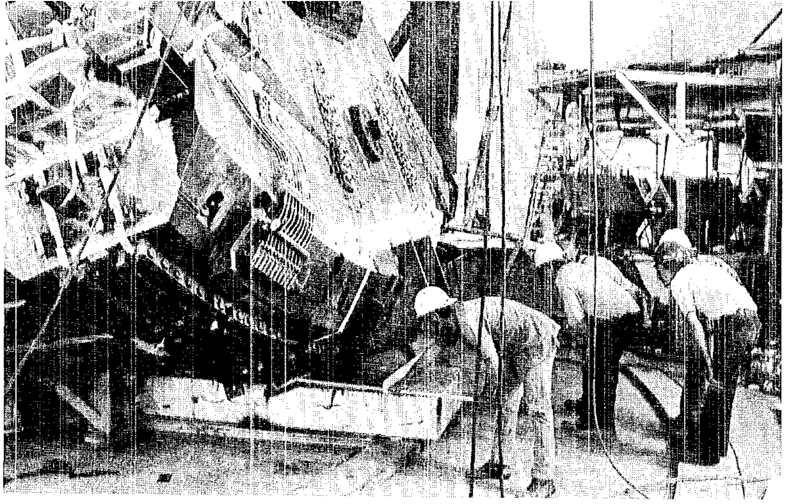
In 1972, the first magnet had been completed by North American Rockwell and delivered to Experimental Area C. The coils and power supplies were also on hand, and the spectrometer frame had been finished. Assembly of the first magnet and later measurements, however, revealed some ill-defined, but significant, problems. With the development of a water leak in the magnet, it was decided early in the summer of 1974 to disassemble, rework, and, in some instances, modify the magnet polepieces.

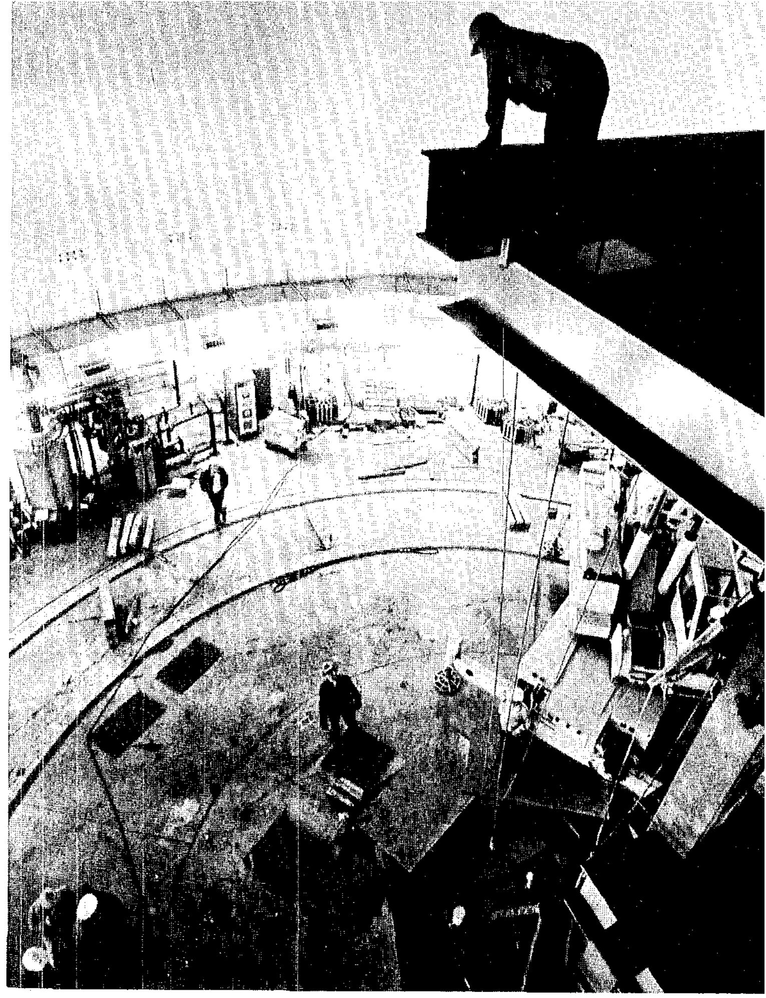
In reworking the polepieces, Wendell Smith, SD-5, Tanaka, Madland, and Wilkerson faced a task so demanding that many said it couldn't be done. The LASL "can-do" team did the job in six weeks. Meticulously, they handsanded the polepieces so that they would fit together with a separation of no greater than 2 thousandths of a millimeter.

Not to be outdone in accomplishing the "impossible," LASL's Shop Department contoured 1-meter iron nosepieces (critical pieces placed at the entrance and exit of each magnet) so that the field boundaries they establish are held within a tenth of a millimeter. Accomplishing this feat were Al Zerwas, alternate Shop Department head, and Gordon Anderson, Danny Brandt, Leroy Wampler, Joe Arellano, Ray McCormick, and Dave Trimmer, all SD-1.

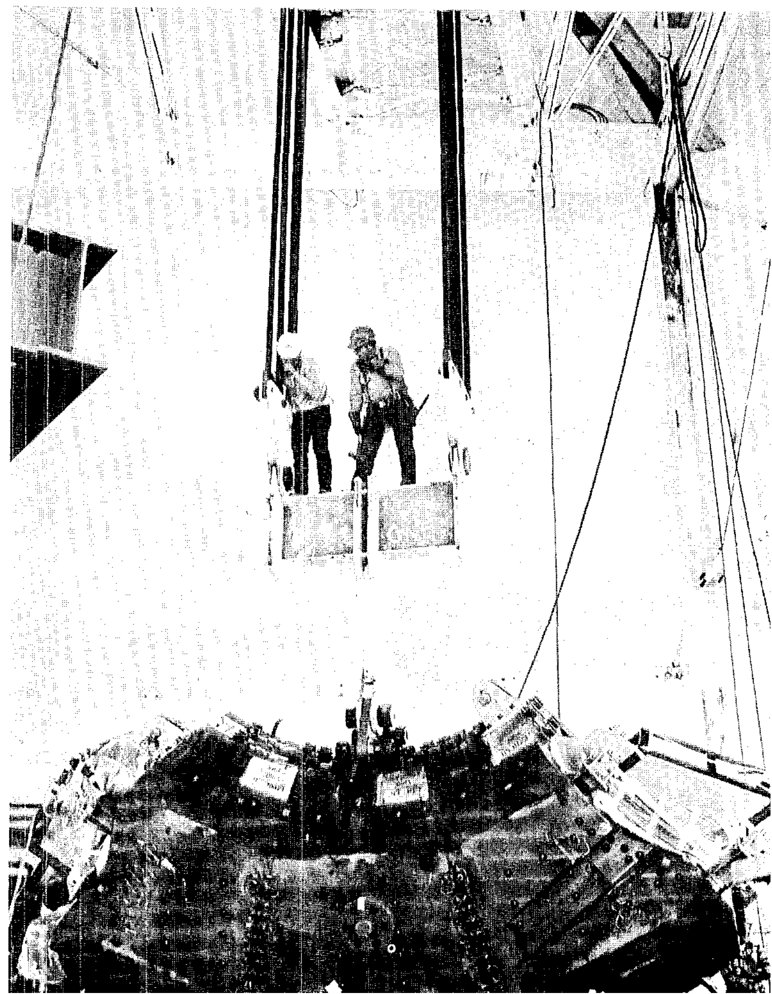
And there were other intricate tasks accomplished, such as engineering and "tuning" the beam line with its 25 magnets, and perfecting a million-watt power system to operate the beamline and the HRS.

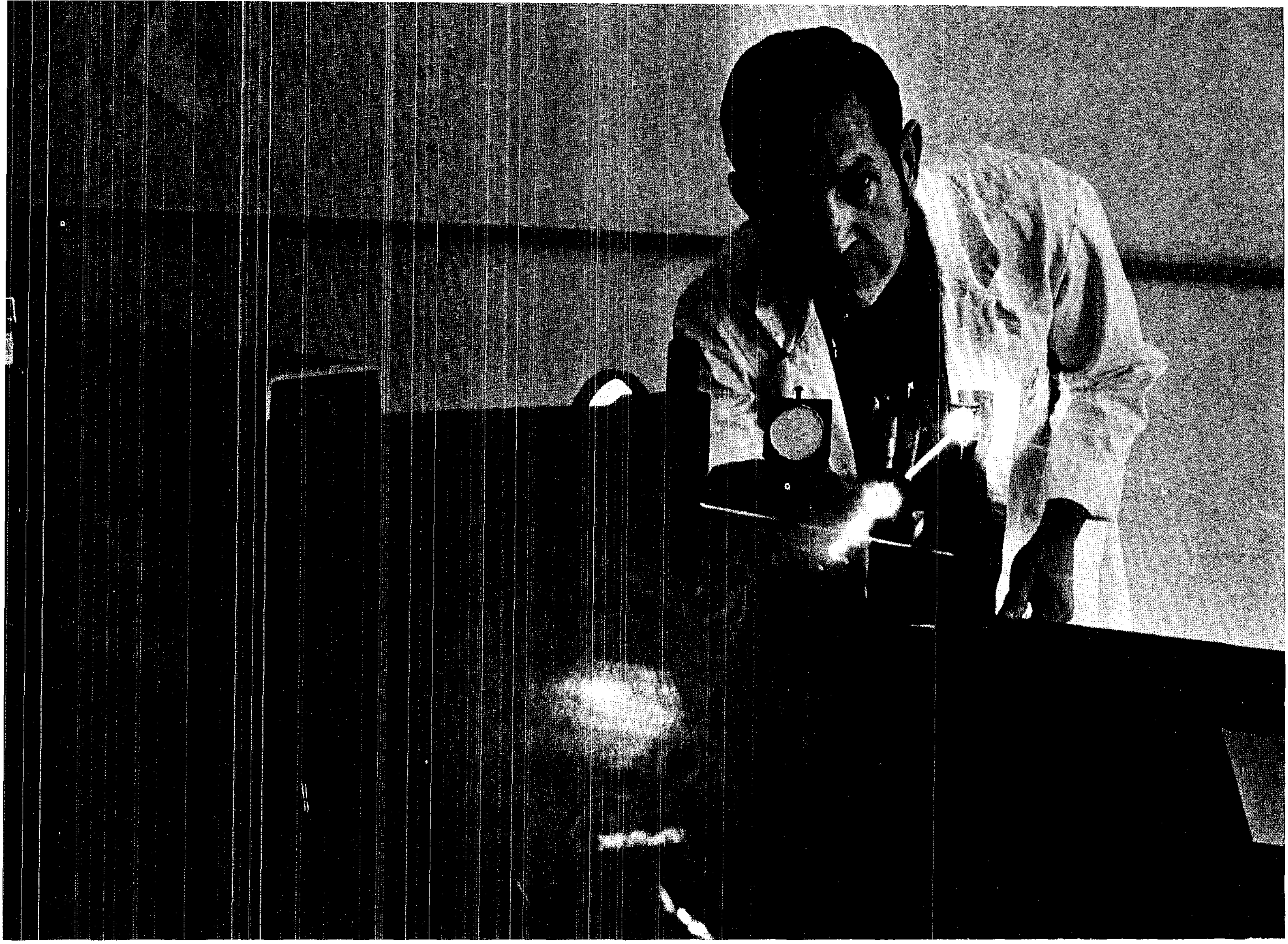
Although the problems were at the limits of technology, and, in many instances, unprecedented, LASL personnel "put it all together." With understandable excitement, LAMPF users from around the world are anticipating conducting experiments with an extraordinary instrument to gain new insights to worlds within.





At left, Stella Fernandez, H-5, tests air for carbon monoxide generated by diesel engines in the enclosed HRS area. Above left, as the first bending magnet is rolled to a lifting position, riggers check to see if its cradle is bending under the tremendous weight. Above right, a view from the top doesn't seem to bother vertigo-proof riggers. Below right, the first magnet is now in an upright position, ready for hoisting. Below, some of those involved with the HRS, some of them for years, watch the ticklish lifting operation. Left to right: Nobuyuki Tanaka, MP-10; Darrel Blankenship, MP-10; Cecil Stark, MP-10; Ray Maestas, P-11; Dave Hodgkins, MP-10; Gene Encinias, MP-10; Jessie Barnhart, MP-10; and Lloyd Wilkerson, WX-4.





Max Winkler, M-1, adjusts laser beams to form a holographic image, in the process creating extraneous patterns of the whorls that one might see on the holographic film itself. The method gives LASL researchers a simple, inexpensive way of viewing graphic computer output in 3 dimensions.

DECEPTION IN 3-D

Or, how you, too, can fool your computer into making honest-to-gosh holograms for science and profit.

Natural is better. And what could be more natural, and therefore better, than viewing a complex mathematical statement not only graphically, but in 3 dimensions, just as we perceive real-life objects. With such a 3-dimensional representation, as in real life, one can look at a subject from various angles, easily discover meaningful detail, and subconsciously get a feel for proportions and relationships.

In computer usage, such 3-dimensional displays can often replace reams of computer printout requiring hours, sometimes days, of subsequent study by a researcher to find the same meaningful detail. And unless he has an unusual feel for mathematics, the researcher may not so readily comprehend the relationships represented by numbers printed on paper.

The most recent, sophisticated, and convincing technique for depicting an object in 3 dimensions is holography. The name was coined in 1947 by holography's inventor, Nobel prizewinner Dennis Gabor, from Greek words meaning "the whole message." And indeed holography does deliver the whole message or close to it. If you look at a hologram of a chessboard and its pieces from a fixed vantage point, you will perceive the image in 3 dimensions through the stereoscopic system by which your 2 eyes and brain perceive depth and distance. But that is not the only way in which you perceive the third dimension. You also perceive depth and distance by moving your vantage point; your brain integrates the differing images. It is the remarkable and unique property of holography to give you these same changing perspectives as you change your vantage point. If you were to move your head about as you looked at the hologram of the chessboard and its pieces, the lines on the chessboard would change angles and the pieces would shift their relative positions just as they would if you were sitting at a chessboard and moving your head about. Holography alone allows you to look at a 3-dimensional image "from all angles."

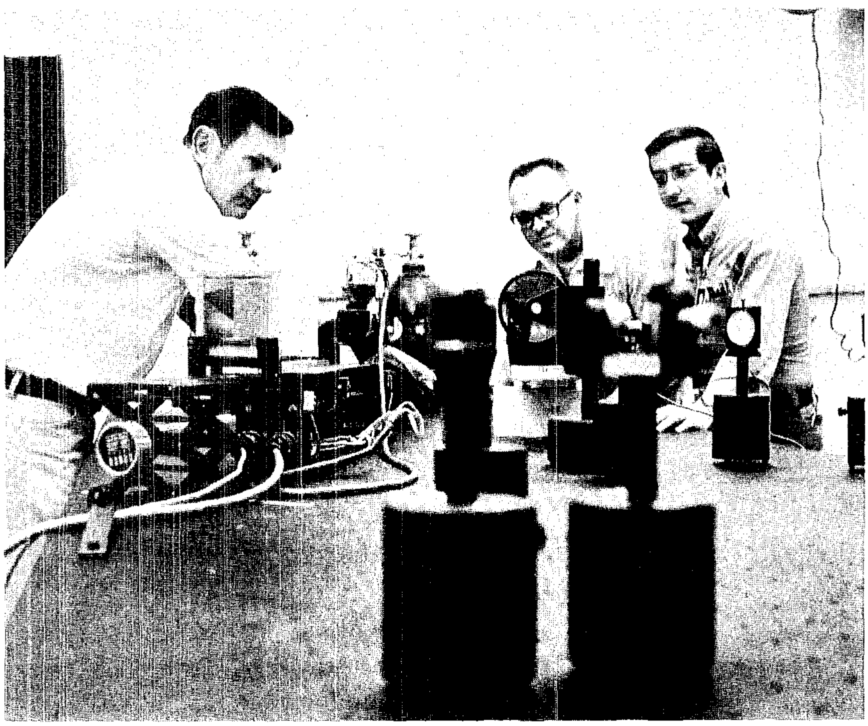
Gabor's holography, invented before the laser was developed, employs electron waves and was designed for electron microscopy. This specialized application did not receive widespread popular notice at the time. In 1963, however, Emmett Leith and Juris Upatnicks of the University of Michigan used then-new lasers to make holograms of ordinary subjects, and holography made the headlines.

In oversimplified terms, holography is based on the physics of wave interference, as seen when 2 pebbles are thrown into a pond. When the resultant waves meet, extra-high "peaks" and extra-low "valleys" are formed with infinite gradations between—an interference pattern. Laser light, because it is monochromatic and coherent, provides the type of uniform, "pure" waves necessary for holography. By splitting a laser beam so that one portion falls directly on film and the other shines on the subject with some of its light reflected back toward the same film, interference patterns are created and recorded on the film. Direct a laser beam (or ordinary light, for that matter) in the proper direction back through the developed film and the recorded interference patterns will reconstruct the image with all its remarkable 3-dimensional properties. Notable features of holography are that no lenses are used to focus the image and the hologram does not look like a conventional photographic negative, but like a piece of accidentally fogged film with no image on it but perhaps some faintly visible whorls.

Creating a hologram using ordinary subjects today is a simple, almost routine procedure. However, generating a holographic image by a computer is a horse of quite another color.

Looking at holograms in another way, they are actually storehouses for astronomical amounts of information (and are used as such in some industrial applications). Special and very complicated codes must be used for computer-generated holograms, and even the huge-capacity, ultrafast computers of the Los Alamos Scientific Laboratory's Central Computing Facility (CCF) would be required to labor long and perhaps with some difficulty

Winkler, Don Dickman, C-3, and Jim Newell, C-4, place equipment so that a split laser beam will form an interference pattern—the principle upon which holography is based. The table rests on air cushions to eliminate vibration.



"*The deception that is perpetrated . . . is that the computer doesn't 'know' that it is making a hologram. It 'thinks' it is just routinely making a series of 2-dimensional diagrams . . .*"

to produce the enormous output required to create a true computer-generated hologram. In addition, the computer would have to be interfaced with a laser/holographic system to form the hologram itself. For these reasons, the technical problems are formidable, it takes too much time, and the costs are very high, which is why computer-generated holograms so far have been restricted to laboratory demonstrations.

Pondering these hard facts of life, yet desirous of joining modern computer technology with holography, Jim Newell, C-4, Don Dickman, C-3, and Max Winkler, M-1, came up with an innovative method that is a snap for present-day computers to handle, uses simple, low-cost, off-the-shelf laser and holographic equipment, and, as the trio cheerfully admits, involves some clever deception.

Slicing Numbers Like Cheese

While producing holograms is extremely difficult for computers, producing ordinary 2-dimensional figures for recording by conventional photography on 35-millimeter filmstrips is not. LASL's CCF has long had computer systems that generate 2-dimensional graphic displays in a fraction of a second, and automatic photographic and processing equipment that turn out thousands of feet of filmstrips daily at pennies per frame.

Given the proper input, computers can just as easily and almost as rapidly churn out a series of 2-dimensional cross sections of a 3-dimensional solid. It's like slicing a piece of cheese of cubic, cylindrical, spherical, conical, or whatever shape. Reassembling the slices reconstructs the original solid form.

In the same way, a series of computer-generated 2-dimensional diagrams can be assembled to give a clear picture of the 3-dimensional mathematical statement which they represent. The deception that is perpetrated in the case of a series like this being later used to make a hologram is that the computer doesn't "know" it is making a hologram. It "thinks" it is just routinely making a series of 2-dimensional diagrams, which it does easily in seconds at very low cost.

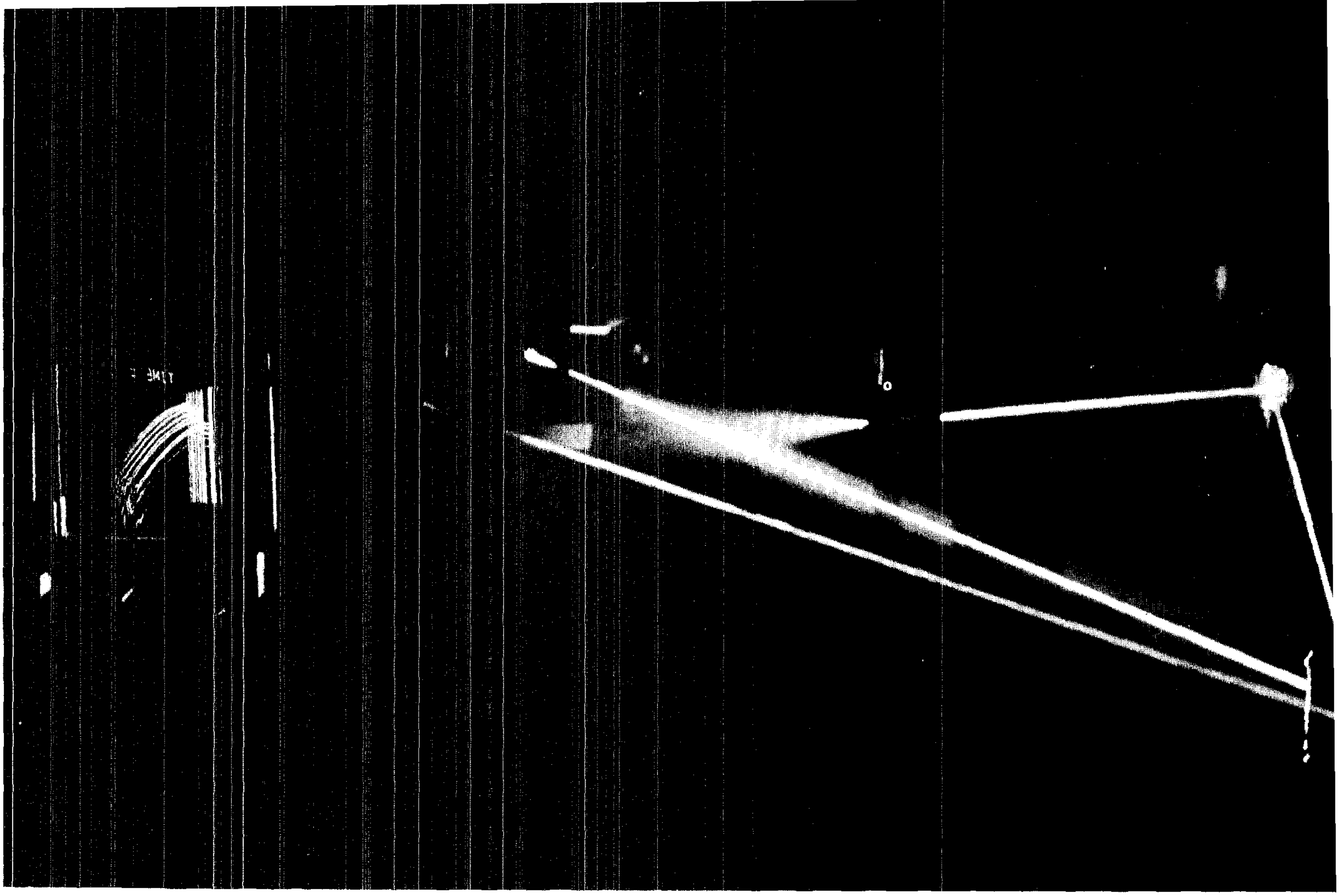
From 2-D to 3-D

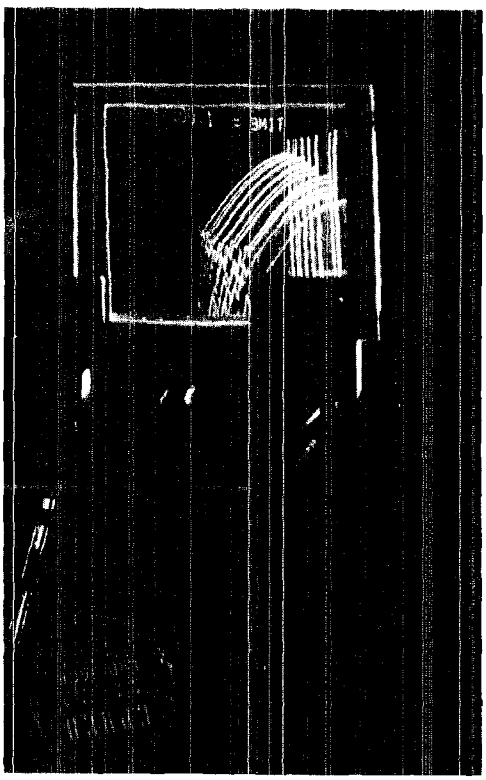
With a film strip of 15 or so frames of these "slices" in hand, what next? Thanks to another unusual property of the holographic process—the ability to record a number of images on a single film with no loss of the holographic effect—all that is required is to make multiple exposures from the filmstrip on a single piece of film.

Almost all, that is. Each frame on the film strip must be exposed at a precalculated distance from the film plane that is greater than for the previous frame. The illusion when the hologram is viewed then becomes one of parallel planes receding back into space. One demonstration hologram presents an illusion similar to viewing a wire phonograph-record rack from one end.

One surprising phenomenon associated with holography can be put to good use. The hologram can be "flipped" and, instead of the image appearing to be behind the film plane, it rather eerily appears to be floating in *front* of the film plane. A viewer can then take a piece of frosted glass and manipulate it in the image area to isolate a particular "slice" of the "mathematical cheese" for more detailed inspection.

Other unusual characteristics of holography may also be put to good use. For instance, 2 or more holograms can be sandwiched and viewed (so long as the light is adequate to pass through the "sandwich") with the resultant image being a 3-dimensional composite of the holograms. And by rotating the holographic film during the multiple exposure process, the image of an object can appear to move as the viewer later moves his vantage point—useful for such tasks as watching a simulated laser pulse moving down a tube.





To better demonstrate holography for **The Atom,** *the investigators* set up a laboratory laser system. At left in the photo above, a holographic image is created. Compare that image with the one directly below it, which was made from a slightly different vantage point, and you'll see that different perspectives are shown. Holography is unique among stereoscopic systems in that subjects appear different from various angles, as they do in real life.

Above left, Newell sets up a portable viewing unit—and unwittingly provides quick-thinking photographer Bill Jack Rodgers, ISD-1, with an unusual picture opportunity through the magnifier. In kindness, The Atom shows Newell as he really looks in the photo below it. At right, Dickman wheels a viewing unit down a corridor to a user.

What Newell, Dickman, and Winkler have accomplished, as they explain it, is not the difficult and costly generation of holograms directly from computer, but the simpler, cheaper construction of holograms from conventional computer output, which is why they titled their informal LASL report "Synthesis of Holograms from Computer-Generated Output."

To operate the system, no more than competent computer programming and the setting up of the laser/holographic equipment with some care are required. The technique of moving back successive frames of a series during exposure is simple and easily learned. Thus, little indoctrination and training is required—an advantage appealing to management in these cost-concious days.

Putting Holographs to Work

Numerous applications, limited only by imagination, can be made of these synthesized holograms from simple building designs to abstract theoretical studies. A typical application is examining the structure of molecules and crystals—from all angles.

To make the method readily available to Laboratory users, Newell, Dickman, and Winkler have built mobile viewing units, mostly with stock items (including a dimestore magnifier), that can be rolled to a user's office. Costs of the first 2 units were less than $150 each, and Newell believes that, with further refinement, costs can be brought down to the neighborhood of $50 each.

As more and more LASL researchers learn how to capitalize on the system's unique capabilities, more and more applications may be discovered. To its developers, the future of synthesizing holograms from computer-generated output appears as bright as the laser beams by which the holograms are made.

short subjects

Honors: **John Clark,** presently a research assistant at the University of California, Berkeley, and **Richard Preston,** T-6, have been awarded J. Robert Oppenheimer Research Fellowships. The fellowships are awarded by the Los Alamos Scientific Laboratory to outstanding recent recipients of doctoral degrees in science or science-related fields and are for one-year terms that may be renewed for a second and possibly a third year.

Clark will receive his Ph.D. in physical chemistry from the University of California, Berkeley, in June. He is a member of Phi Beta Kappa and has received undergraduate awards as both the outstanding chemistry major and the outstanding physics major. He will work in L-Division.

Preston received his Ph.D. in physical chemistry from Yale University in 1972, has conducted research as a postdoctoral fellow at the University of California, Berkeley, and is a member of Phi Beta Kappa. Preston will continue to work in T-Division.

Peter Carruthers, T-Division leader, was recently elected by members of the Division of Particles and Fields of the American Physical Society to the Executive Committee of that division. Carruthers has also been appointed to the Physics Advisory Panel of the National Science Foundation.

The Los Alamos Scientific Laboratory is now accepting applications for the September 1976 class of its Machinist Apprenticeship Program. Interested men and women should apply at the LASL Personnel Department by 5 p.m., February 27, 1976.

From ERDA: **Charles Hitch,** president of a Washington-based private research institution and former president of the University of California, has been elected Chairman of the General Advisory Committee to ERDA. Hitch served as president of the University of California from January 1968 to June 1975.

F. Gilman Blake, a physicist at Los Alamos from 1944 to 1946, has been named assistant director for Policy and Planning, Division of Geothermal Energy. Blake served in management positions in private industry, later held government posts including that of Senior Policy Analyst, Science and Technology Office of the National Science Foundation.

Thomas Clark has been appointed deputy manager of the Albuquerque Operations Office. Clark was previously an executive assistant in the Office of the Assistant Administrator for Nuclear Energy, Washington, D.C., from the time ERDA was established in January 1975. From 1963 to 1975, Clark held various positions with the U.S. Atomic Energy Commission's Division of Military Application.

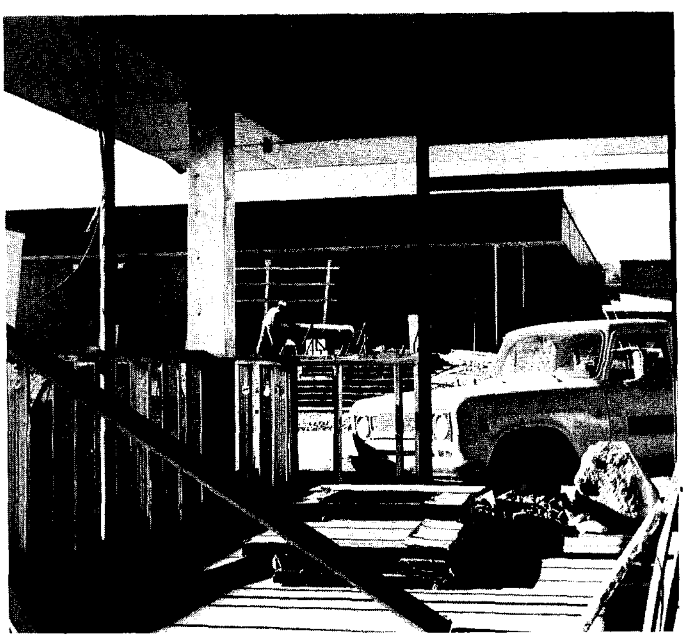
Retirements: **George Allen,** WX-3, lead operator; **Elizabeth Tynan,** C-1, EDP assistant shift supervisor; **Charlotte Pfaff,** WX-7, detonator technician; **John Furchner,** H-4, staff member; **Joseph P. Doherty,** SD-5, laboratory machinist; **Mabel Peck,** AO-2, junior accountant.

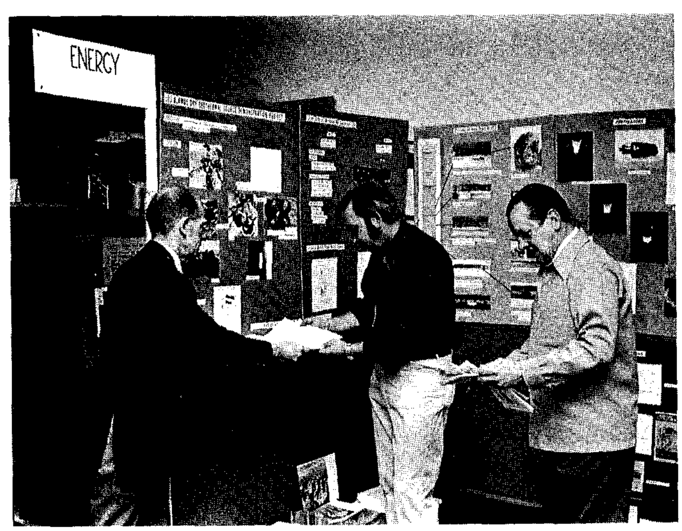
Dwight Young, a LASL staff member from 1944 to 1959, died December 24, 1975, at the age of 83 in Illinois. Young was a colorful personality well-known for his versatility and individuality. On his retirement, the "Community Affairs News" described him as "a carpenter, photographer, handyman, archeologist, cook, meteorologist, poet, and self-made physicist." He was nicknamed "The Hermit of Pajarito" when he lived for several years in a log cabin to be near ruins he was excavating in Pajarito Canyon. Among his exploits was "home-building" a low-cost reactor as a neutron source for experiments he was conducting. Among his survivors are one daughter, three sons, and several grandchildren and great grandchildren. He had lived in Caney Creek, Texas, until shortly before his death.

Deaths: **Lynn Staker,** J-6 (NTS), liaison engineer.

Photo Shorts

It's an ill wind that blows nobody good, and Los Alamos' balmy winter weather allows continuing construction unhampered by snow and cold. At the National Security and Resources Study Center, top photo, workers smooth concrete by afternoon light. Completion is planned for early fall. In the middle photo, the large "anthill" is actually soil banked for radiation shielding over the Weapons Neutron Research Facility, completed in January. Installation of equipment is in progress. Below, construction of the new Plutonium Processing Facility on Pajarito Road has progressed to the point where security inspection stations are now being built.





Unfortunately, there were no scenes like this during January in Los Alamos. Kerry Wilson, H-8 meteorological section, reports only 1 inch of snow (equivalent to .08 inch of rain) fell on Los Alamos during January. This barely exceeded the snowfall of the very dry January of 1970, but amounted to only 1/15 of the snow that fell on Los Alamos in January of last year. Wilson attributed the dry spell to the Pacific high being exceptionally strong, preventing Pacific storms from entering the North American continent. The same phenomenon is responsible for California's severe drought.

Putting our best energy foot forward at the national meeting of the National Society of Professional Engineers held January 19-23 at the Hilton Inn in Albuquerque are Roland Pettitt, Q-22, William E. Wood, Q-DO, and Roger Westcott, Q-DO. The display they're assembling depicts LASL's many energy programs.

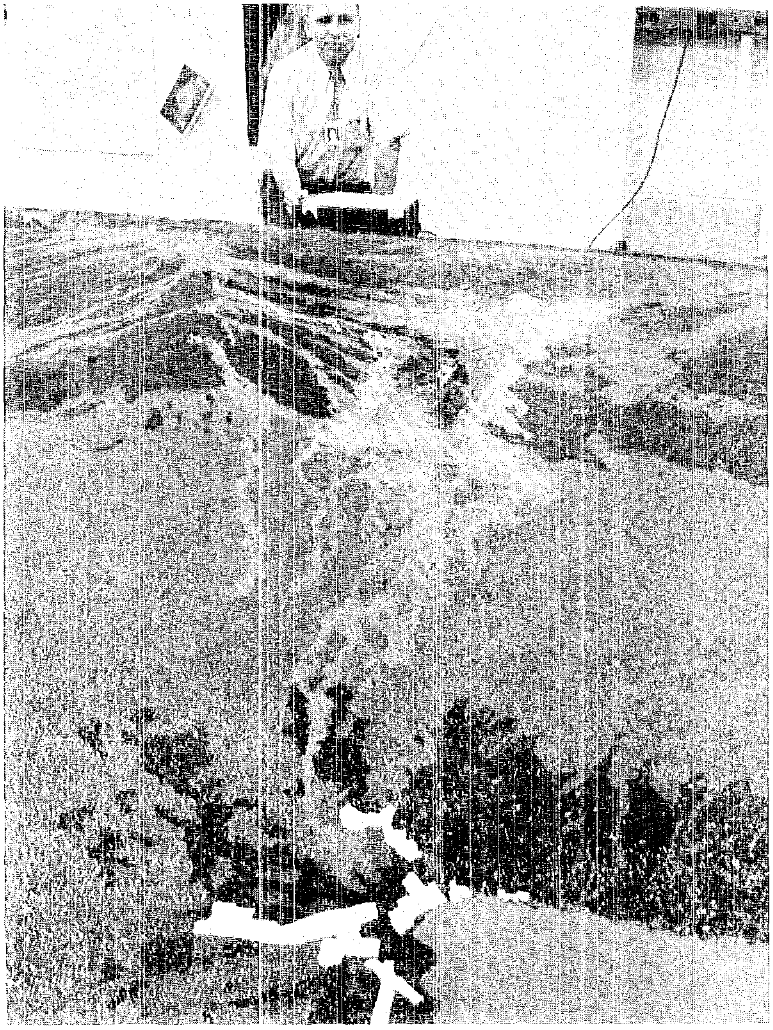
A scale model of Mauna Loa on the island of Hawaii erupts as hot wax begins emerging from a vent in the first picture, flows part way down the volcano's slope in the second, and reaches the environs of the oceanside city of Hilo in the third. Operating the controls are Joe Neudecker, WX-8, and Roberta Widdicombe, summer graduate student. "I don't think we'll wipe out Hilo," Neudecker had earlier predicted. They didn't.

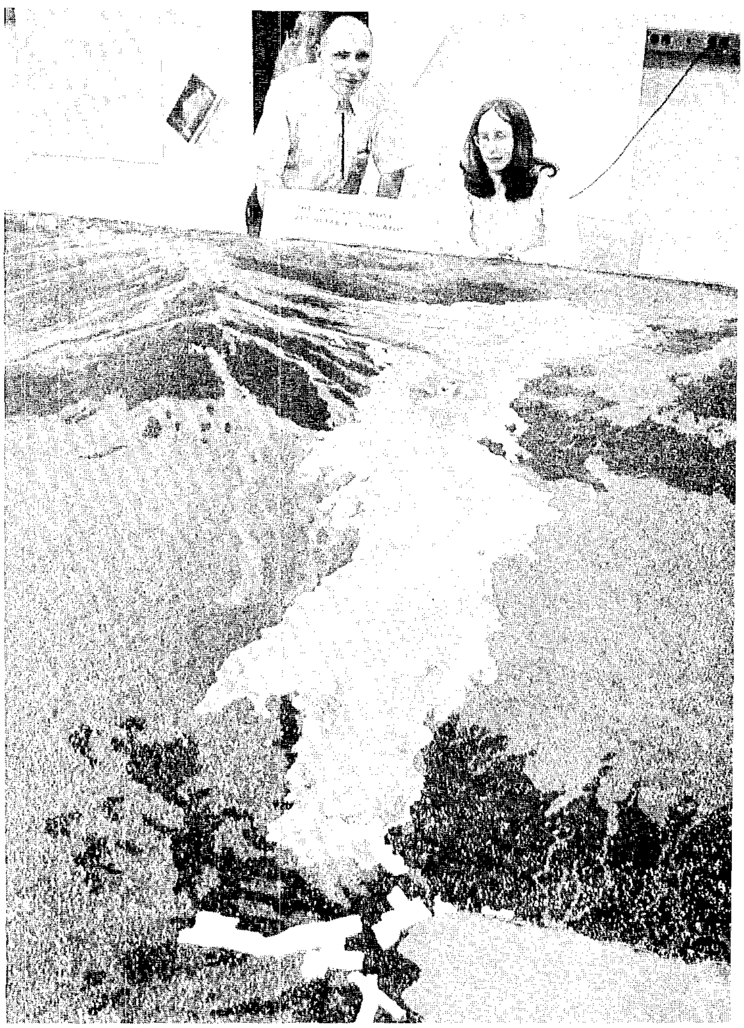
Thar She Blows!

The earth shakes ominously, smoke billows faster from the distant cone, and then the towering volcano erupts. Clouds above it are bathed in eerie orange light as glowing lava flows irresistibly down the volcano's sides, moving boulders, toppling trees, and causing all things combustible in its path to burst into flames.

Such is the popular conception of a volcanic eruption, although vulcanologists are quick to point out that there is a great deal more to a volcanic eruption than that, and that all volcanoes do not erupt in the same way. But, at the same time, they add that a major eruption can be more violent, more destructive, more dangerous—and, in its own terrible way, more beautiful—than even words like these can describe.

History has recorded many spectacular volcanic disasters—Mount Vesuvius, Krakatoa, and Mount





Etna, to name a few of the better known. The threat posed by volcanoes appears no less today than it was yesterday. Many geoscientists believe that recent activity in the Hawaiian Islands and of Mount Baker in the state of Washington indicates that these areas may be on the verge of more frequent volcanic eruptions and potential disasters.

Which is why Group Q-21, which deals in all phases of geoscience with special emphasis on vulcanology for possible geothermal and subterrene application (**The Atom,** Sept.-Oct. 1974), believes that the question of lava flow—its prediction and possible control—is more urgent than many realize.

To find some answers in a simple, straightforward way, Group Q-21 came up with a simple, straightforward technique: scale-model simulation. By making a very accurate topographical scale model of a volcano and the terrain in its vicinity, and then ejecting a viscous fluid, such as hot wax, from the volcano's vents, investigators could see for themselves just where and how far the lava would flow.

The subject chosen for this scale-modelling was Mauna Loa, some 35 miles from the city of Hilo on the island of Hawaii, because that volcano, judging by very recent activity, appears to be a likely candidate for large-scale eruptions in the foreseeable future. Man-made barriers to alter lava flow have been successful in other areas; Group Q-21 would like to study the feasibility of this type of control for Mauna Loa, in addition to conducting other studies such as determining safe sites for tapping the magma chamber itself as a source of geothermal energy.

The project appealed to Roberta Widdicombe, a summer graduate student from the University of New Mexico. With the assistance of David Mann, Q-21, she investigated ways to build a scale model of Mauna Loa to the accuracy required, and began work last summer. To duplicate the exact slope and contours of Mauna Loa and surrounding terrain, metal tubes were cut to lengths corresponding to elevations shown on a topographic map. These were used as jigs through which color-coded nails were hammered into a plywood base until the heads were flush with the tops of the tubes. An aggregate of coarse sawdust, plaster, paste, and glue was rough-filled as a base between the nails, followed by a similar, but finer, finish coat carefully smoothed to be flush with the heads of the nails. The whole 12-by-14-foot model was then realistically painted.

As this work progressed, Joe Neudecker, WX-8, and John Buchen, E-4, designed and built a reservoir and pumping system for ejecting hot wax. The mechanism provides temperature, volume, and rate-of-flow controls, and has tubes leading to the 4 vents of the volcano so that it can be made to erupt in a variety of modes.

Roberta found the project fascinating, but more time-consuming than she had anticipated. She worked on it all summer right up to the moment when the model with the hot-wax mechanism installed was operated for the first time on December 19. With some 40 spectators watching, a switch was closed, the volcano did its thing, and the "party" was a success.

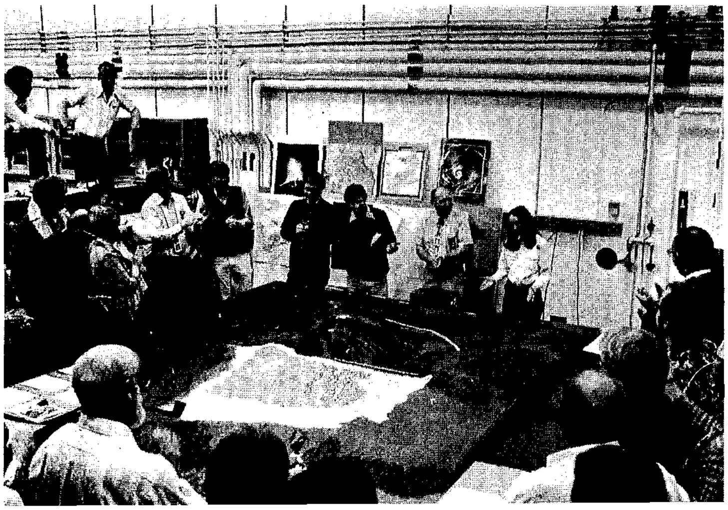
Group Q-21 views the completed model with satisfaction and is beginning a series of studies with it. The model complements, but does not replace, computerized modelling of volcanoes. "Both methods have their advantages," says Tom McGetchin, Q-21 group leader. "The scale model gives us an opportunity to spot details and ask questions, so to speak, that may not be apparent in computer simulations."

If the Mauna Loa scale model proves as useful as Group Q-21 believes, the group hopes that scale models of other volcanoes, especially of those in proximity to inhabited areas, can be built.

And if Mauna Loa, which showed activity as recently as July of last year, becomes active again, Roberta Widdicombe's painstaking work last summer could be more timely and valuable than she could have known.

Above, Roy Norris and Richard Renfro, both Q-23, make last-minute adjustments on the hot-wax pumping system they helped build prior to loading for delivery as Joe Neudecker, WX-8, watches. Below, Roberta Widdicombe and Tom McGetchin, Q-21 group leader, check details on the scale model.

"Aw, shucks," says Roberta, 'it was nothing!" as she receives a round of applause from LASL personnel at the scale model's first performance. Roberta could not complete the painting of the light area on the model before the unveiling, but the "party" went on anyway.



Johann Stoyva, University of Colorado, talks about stress and biofeedback at a LASL colloquium on Dec. 17.

speaking of stress

One hundred and fifty years ago, 85 per cent of deaths resulted from communicable diseases: smallpox, syphilis, and the like. As the science and medicine of the times assaulted communicable diseases with mounting success, the industrial revolution was, unbeknownst to its creators, generating the conditions for a new genre of ailments stemming from stress. Today, 50 per cent of deaths are attributable to cardiac and vascular ailments which, in turn, are frequently associated with stress. Interestingly, excessive cholesterol in the blood may not be quite the archvillain as currently believed. Until time changed a life-style, the inhabitants of a small town in Pennsylvania subsisted on a very high-cholesterol diet, yet few deaths were attributed to cardiovascular causes. The population lived in a relaxed, secure, and, therefore, largely stress-free manner. When stress and high levels of cholesterol are both present in a person, however, look out!

That modern American life, especially in such an achievement-motivated and highly organized place as the Los Alamos Scientific Laboratory, produces stress is no surprise. The manifestations of stress are many and affect those vulnerable to it in one or more ways. Anxiety, depression, migraine headaches, high blood pressure, gastric disturbances, sexual and family problems, alcoholism, drug abuse, and suicide are some of the principal unwanted products. There are those who believe the list could be lengthened to include a great many ailments and diseases not commonly linked to stress today.

If stress is not only a fundamental medical problem, as many believe, but a matter of widespread personal concern, then it is understandable that a colloquium at LASL on December 17 was unusually well attended. Speaking on stress and recently developed ways to deal with it was Johann Stoyva, psychologist in the Department of Psychiatry at the University of Colorado Medical School and editor of a new journal, *Biofeedback and Self Regulation.* What he had to say was not only of objective scientific interest, but for many in the auditorium held deeper and more intimate meaning.

As Stoyva remarked, "In our society, we have placed a great deal of emphasis on effort and achievement, and this is necessary. However, we have largely ignored stress and how to cope with it so that we may also live healthier, longer, and happier lives." Many heads in the audience nodded unconsciously in agreement.

Of Mind and Body

Man has long known that the mind can influence the body and vice versa, although he has not always been able to explain this relationship and the mechanisms involved. Schools of thought and practice of Eastern origin seeking to understand and manipulate mind-body relationships, such as yoga and transcendental meditation, are typically clothed in a mysticism repugnant to many traditional Western scientists. And to the discomfiture of serious Western investigators, biofeedback is often mistakenly associated with psychic phenomena such as clairvoyance, "talking to plants," and the like.

In recent years, a nonmystical and more systematic approach to understanding mind-body relationships, called biofeedback, has evolved which relies on Western techniques. Electronic instruments are used to measure faint voltages, temperatures, and other bodily signals. These, in turn, are translated into visual or audible signals that can be read by the subject. By monitoring his own body signals, the subject can learn to regulate the particular bodily function involved. Associated with this learning process is a state of mind difficult for even articulate investigators to describe. It is called "passive volition," which is a conscious but relaxed state during which no disciplined reasoning takes place. Or, put another way, you can't consciously command yourself into this state—you *must* train yourself to drift into it.

Once in this state, many subjects are able to regulate a number of bodily functions, including many which researchers until recently thought were impossible to control, such as body temperature in specific areas, blood pressure, and pulse rate. While biofeedback is a physiological rather than a psychological approach (the underlying cause of stress is not addressed as it is in psychiatry or psychology), it nonetheless seems to work both ways for many subjects. The mere act of controlling bodily functions seems to relieve psychic stress to some degree for reasons not yet clearly understood.

While biofeedback is not universally recognized as a true discipline, a growing number of scientists and physicians are at the least open-minded on the subject and at the most are actively investigating it and using some of its more tested techniques clinically. The recently formed National Biofeedback Research Society now numbers about 1000, with membership consisting mostly of physcians, psychologists, and scientists. Research and application is in progress at a number of universities and respected medical facilities.

Perhaps the major obstacle to biofeedback's unquestioned acceptance as a true discipline lies not in its methodology, but in the matter of reproducibility—a cornerstone of Western science. A physics experiment, for instance, can always be reproduced given the same conditions. The same conditions cannot exist from experiment to experiment in biofeedback because the "targets" are humans. Humans vary in their physical, mental, and emotional states from day to day, even from hour to hour. And with different human subjects, by definition, the conditions cannot be the same. Some humans do not even generate a detectable alpha wave, a particular brainwave associated with a relaxed, drifting state of mind.

Nonetheless, biofeedback has scored impressively high "batting averages" in a number of applications. For example, 80 per cent of migraine-headache sufferers who learned to raise their hand temperature through biofeedback techniques at the Menninger Foundation in Topeka, Kansas, reported that their pain had been eliminated or greatly reduced. It is surmised that because bodily temperature and the dilation and contraction of blood vessels in the brain are both regulated by the same nervous system which regulates all bodily functions, controlling one function beneficially affects the other.

Biofeedback at LASL

The nationwide interest in biofeedback has, perhaps inevitably, found its way into LASL, where intense scientific curiosity is a way of life. An informal group varying from 10 to 25 LASL personnel and Los Alamos townspeople has been in existence since 1974. The group meets on many Fridays during the lunch hour at the South Mesa cafeteria and from time to time in evenings at members' homes. Membership cuts across division lines and encompasses all walks of professional life from administrative to technical to postdoctoral staff members. Motivations range from simple curiosity, to the desire to achieve better self-understanding, to employing biofeedback toward the relief of stress effects upon themselves or members of their families.

Because there is no official program for biofeedback research at LASL at present, the group has "passed the hat" among themselves to purchase some equipment, while a few members, skilled in electronics, have made their own equipment, which they frequently share with other members. The equipment available to members consists of 3 basic units; an electroencephalograph (EEG) to measure brainneural voltages in microvolts, an electromyograph (EMG) to measure muscle-neural voltages, an index of muscular tension, and a temperature monitoring device. The EEG is the most fascinating to observe as brainwaves from the subject are translated to an audible "squêal" of varying frequency. For the first-time observer, it is an eerie feeling to realize that one is listening to a brain in operation.

Especially interested in biofeedback as a clinical technique is James Brown, program coordinator for the Los Alamos Council on Alcoholism. "There is convincing evidence that many alcoholics are more vulnerable to stress than nonalcoholics. The world acts upon them with greater impact than upon others. Presumably, they become dependent upon alcohol to dull the effects of stress. If they can learn to relieve stress effects through biofeedback techniques, then perhaps their dependence upon alcohol can be reduced or eliminated," Brown says.

Although Brown has not employed biofeedback clinically to date, he plans to begin using biofeedback techniques this winter with selected clients who are referred to him by physicians.

Both he and his wife, Molly Brown, E-DO, are active members of the LASL biofeedback group. Other LASL personnel currently involved include Dale Holm, H-6, Bill Jarmie, P-9, John Manley, consultant, Helen Fuller, WX-5, Bob Lanter, WX-6, Al Koehle, E-3, Kirk Smith, P-9, and Martha MacMillan, wife of Don MacMillan, WX-5.

During their luncheon meetings, members occasionally hook up equipment to subjects, counsel each other on equipment use, discuss latest research findings from other

James Brown, Los Alamos Council on Alcoholism, adjusts sensors placed on his wife, Molly Brown, E-DO, for a biofeedback demonstration during a lunch-hour meeting at the South Mesa Cafeteria. Watching, left to right, are Kirk Smith, P-9; Bill Jarmie, P-9; John Manley, consultant; Jon Sollid, L-1; Dale Holm, H-6; Al Koehle, E-3; and Bob Lanter, WX-6.

institutions, and report on personal experiences. One member reported that his wife, a long-time sufferer from migraine headaches, had obtained considerable relief from this ailment through biofeedback and had become less dependent upon medication. Another discussed evidence from another institution showing that biofeedback seemed to be effective for a large number of cases involving muscular control ranging from epilepsy to making muscles in various parts of the body operative which had been paralyzed for long periods of time. And a third member commented on some evidence that stress-free individuals seem to have a greater resistance to bacteriological and viral diseases, and speculated that biofeedback might prove effective in preventing communicable diseases, including certain types of cancer, not usually thought of as associated with stress.

The group has proposed, in an informal way, that LASL could profitably involve itself in biofeedback in 3 ways: as a developer of sophisticated electronic biofeedback equipment for other institutions, thus capitalizing on the special expertise LASL has acquired in designing innovative and advanced instrumentation; as a user for certain personnel health problems at LASL itself; and as a contributor of new knowledge to the scientific community at large through original research. Realistically, the group acknowledges that in a laboratory such as LASL, grounded in traditional physical sciences, an established funded program may be some time in coming.

Yet, group members also point out that LASL has expanded far beyond strictly physical research in a number of fields: biology, environmental sciences, and occupational safety and health, to name a few. With LASL's areas of interest continually expanding, it may not be all that farfetched that LASL will someday consider biofeedback a logical field for research and development.

If and when that day comes, LASL will find a *de facto* interdisciplinary group already in existence and more than willing to continue its investigations.

Respirator Road Show

On Monday, January 5, Darrel Douglas, section leader, John Pritchard, alternate section leader, and Alan Hack, all H-5 (Industrial Hygiene) and members of that group's respirator section, arrived at the Sheraton Inn Washington-Northeast, New Carrolton, Maryland. Not only were they the producers and cast of a new and unusual roadshow, but, of necessity, the stagehands and grips as well. They spent the day unpacking their props for the 3-day production that was to follow.

It was not the first of the "road company's" shows. Since October, members of the group have "played" in Denver, Chicago, and Pittsburgh. But it was one of the more important. In addition to representatives from industry and nuclear plants, a sizeable turnout of Occupational Safety and Health Administration (OSHA) officials from nearby Washington, D.C., was expected. Hopefully, LASL's 3-day "Respiratory Protection Program and OSHA Training Course" would convince OSHA personnel of the importance of a course of this type.

The H-5 respirator section has held similar training courses at the Los Alamos Scientific Laboratory since April, 1973 (*The Atom,* September 1973), but with the almost explosive growth in standards and regulations and the need of industry everywhere to understand and use respirators on an increasing scale, LASL investigators had concluded that Laboratory sessions were no longer sufficient; the information and instruction had to leave "The Hill" and get out in the field.

Attracted by both the "smell of the greasepaint and the roar of the crowd" and the special importance of this particular presentation, *The Atom* editor Jack Nelson and

Heading for their 3-night "stand" near Washington, D.C., are LASL's respirator "troupers" Daryl Douglas, Alan Hack, and John Pritchard, all H-5.

photographer Bill Jack Rodgers, both ISD-1, flew to Washington to catch up with LASL's troupe and bring back a first-hand account of what went on.

The Atom staffers joined the "audience" at the Sheraton during the closing minutes of the first-day session and learned there had been 39 registrants: 23 from OSHA, 6 from the National Institute for Occupational Safety and Health, and 10 from nuclear power plants and industry. Each had paid $290 for 3 full days of lectures and hands-on demonstrations, a manual at least 3 inches thick, and 3 luncheons.

As a matter of practical definition, respirators are devices ranging from throwaway cloth and paper nuisance dust masks, costing less than $1, to elaborate self-contained breathing systems complete with "astronaut" suits, costing several thousand dollars, that protect wearers against hazardous particles and gases.

The use of respirators dates from antiquity and they have been common in mining and not entirely unknown in other industries since before the turn of the century. It is only in recent years, however, that respirators have become one of the "hottest" items in the growing and increasingly complex field of occupational health and safety.

Hack points out typical half-masks during intensive respirator instruction sessions. The training course was heavily attended by interested OSHA personnel.

From Pliny to OSHA

In the days of the Roman Empire, Pliny (A.D. 23-79) wrote of miners wearing loose-fitting animal bladders for protection against red oxide of lead. Some 100 years later, the respirator had been improved with a sack-cloth filter, according to the Roman writer, Julius Pollos (A.D. 124-192). Almost 1400 years later, Leonardo da Vinci (A.D. 1452-1518), perhaps the most versatile of Renaissance men, designed a "wet cloth" mask for chemical warfare and an underwater breathing device with a float and snorkel-like tube.

Concurrent with the birth and growth of the Industrial Revolution in the 1800's, primitive face masks and respirators began to appear in some industries and mines. Silicosis, the respiratory disease caused by rock dust, afflicted thousands of miners and dramatized the need for respiratory protection for American workers.

In 1919, the U.S. Bureau of Mines began approving self-contained breathing apparatus and gas masks. Other agencies of the federal government, such as the Atomic Energy Commission, predecessor of today's Energy Research and Development Administration, have investigated the use of respirators for the protection of workers exposed to serious health hazards. In some industries, labor-management negotiations have brought about stringent requirements for respirators to protect workers' health and safety.

Nevertheless, usage of respirators in industry as a whole until recently has been neither widespread nor uniform, depending more on the benevolence of a given company and interpretation of loose recommendations than upon national standards and federal requirements enforced by inspection. In 1970, the passage of legislation with far-reaching implications by the U.S. Congress, the Occupational Health and Safety Act, made respirators a "whole new ball game." Standards previously adopted in 1969 by the American National Standard Institute (ANSI), which were recommendations but not requirements, that pertained to respiratory protection became the first sections of OSHA's respiratory regulations, now backed by the "clout" of federal inspection and enforcement. All places of employment except governmental agencies were broadly covered in the act, from shipbuilding to rock bands. Suddenly, American industry became conscious of the need to protect its employees from respiratory health hazards.

Today, there are about a dozen manufacturers of respirators who, while not releasing sales figures, advertise vigorously in trade journals and apparently enjoy significant markets. Unofficial estimates place respirator sales at up to $100 million a year, with an annual 10-15 per cent annual growth anticipated. The copper mining and smelting industry of Arizona alone requires respirators for 20,000 employees.

With this sort of present interest and future growth, small wonder that the LASL respirator section, which has developed unique expertise through its work in respirators since the early 1950's, believes strongly that the time has come to move its respirator know-how directly into the hands of industry through training courses held in key cities throughout the country.

Shall, Should, and May

Because the Occupational Safety and Health Standards regulations pertaining to respirators, popularly called "1910.134," have stringent guidelines for the selection, use, and maintenance of respirators as well as for the administration of respirator programs, and because they present, especially to the novice, difficulties in interpretation, the first day of the Respiratory Training Course was dedicated largely to explanations of these requirements and how typical industries can set up respirator programs in compliance to them.

In general, the requirements are stated in terms of "shall," "should," and "may." "Shall" is a mandatory statement and requirements stated with "shall" are clear-cut. Not so with "should" and "may." It takes some doing to relate these types of guidelines to other "blanket" requirements that may or may not take precedence, and with current interpretations and policies of OSHA. If this sounds confusing, it also explains why the topic required almost a day to clarify for the students.

In addition, some industries also comply with regulations issued by other agencies, such as by the Nuclear Regulatory Agency, and by state and local governments.

Fun and Games

On Wednesday, the second day of the course, the fun and games began. Perhaps a hundred respirators were displayed and, with the legalisms behind them, the pupils could begin to learn what respirators in the palpable as well as the abstract were all about.

Hack took the stage at the beginning and dealt in some fundamentals. Respirators can be classified in various ways, he said. One way is by the size of the face mask. A quarter mask extends from the nose to above the chin. Hack called it the cheapest, smallest, simplest, most common—and least reliable. However, the latter is no disadvantage under the proper conditions, such as where levels of relatively low toxicity are encountered and where less-than-perfect performance would pose no significant hazard.

The half-mask extends to below the chin, is more stable, and thus affords greater sealing protection. The full facepiece covers the eyes with goggles or visor as well as extending below the chin, affords the greatest sealing protection, and is used in more hazardous situations and with self-contained and air-supplied systems, such as equipment for firefighters.

Pritchard's "act," which followed, elaborated on the more sophisticated equipment for self-contained and air-supplied systems. Self-contained systems use air tanks, as for scuba gear, while air-supplied systems rely on compressed air from hoses. Some systems are dual with provisions for the user to draw on either tanks or hose.

The subject of providing suitable air to be compressed in tanks proved to be a technology in itself, as it may not be sufficient to draw air from the atmosphere in proximity to the exhaust from the compressor engine. Vaporization and combustion of lubricating oil in the compression unit is a special problem. Temperature monitoring, carbon monoxide measurement, and the use of compression units that dispense with oil lubrication are 3 of the solutions. Another is to "manufacture" air from liquid oxygen and nitrogen, bypassing the problems of compressing natural air entirely.

Douglas then "took the spotlight" to discuss filters. Basically, these are designed for 2 functions: to screen out undesirable particles and to neutralize or remove toxic gases and vapors. A filter designed for one purpose may be useless for the other, and more than a few health problems have arisen from workers using the wrong type of filter.

A common and effective type of particulate filter relies on an electrostatic charge imparted to the filter material, typically a wool felt, during manufacture. This principle works well unless the charge is dissipated by excessive humidity or heat. Most face masks incorporate exhaust valves so that the heat and humidity of the wearer's exhalations are expelled directly to the outside atmosphere so as not to impair the filter's efficiency.

Other particulate filters do not rely on electrostatic charges, but on simple filtration. Chemical filters, called canisters or cartridges "in the trade" and designed to remove toxic gases and vapors, rely on activated charcoal or a chemical agent to neutralize or absorb toxic substances. A few filters combine both functions.

Hack returned to discuss some of the facemask evaluation results learned at LASL and found himself involved in one of the livelier discussions of the day. Briefly, LASL has long tested face masks on a variety of subjects selected to represent the distribution of facial types in the population at large. To measure sealing effectiveness, LASL compares the contaminants measured in the atmosphere surrounding a subject with the contaminants detected within the facemask of the subject. The ratio of the first to the second produces an index, called the Protection Factor, allowing comparison of the protection afforded by one facemask against another as well as being useful for other computations.

Richard Whittier, OSHA, challenged the Protection Factor as being misleading, holding that the only measurement of interest insofar as the user's safety is concerned is that of the contaminants within the mask. As is so often true in arguments of more than

Above, Richard Ronk, OSHA, tests the sealing effectiveness of his face mask by "puffing" odoriferous vapor about the mask. Above right, Daryl Douglas, H-5, and Linda Anku, OSHA, help Raymond Lloyd, Maryland Department of Labor, adjust his mask during a "hands-on" session. Right, The Atom editor, Jack Nelson, ISD-1, learns more about the respirator "business" from John Pritchard, H-5, and Arthur Gass, OSHA.

basic nature, there appeared to be merit on both sides. On the one hand, the Performance Factor is a useful numerical statement of a respirator's efficiency. On the other hand, it is undeniably true that the only measurement that matters in the end is the amount of hazardous material being inhaled by the respirator user. The debate subsided with the recognition that more than Protection Factors are involved in respirator selection and that these should be applied with judgment and used along with other criteria.

Fitting respirators to humans—and getting them to use respirators—is a fledgling art or science, or both. One manufacturer employs a sculptor to make models of various human heads on which pilot-model masks are fitted. This manufacturer scores well overall in having its masks fit a wide variety of people. Somewhat ignored until recently have been fitting masks to female faces, generally smaller than those of males, and in allowing for eyeglasses, now worn by about 60 per cent of the adult population.

Assuming that proper masks are properly fitted, a problem still remains in getting workers to use them and use them correctly. Respirators at best are uncomfortable, and when the need to wear them is not well understood and accepted, some employees will not willingly wear them. In some work places, unprotected masks and respirators have been found hanging from pegs collecting toxic dust in the process. Upon use, these masks may produce an atmosphere within the mask more heavily contaminated with the dust than if the user were not wearing a mask. Education and training are the most promising answers.

Pritchard then discussed testing respirators for use. Testing is classified as qualitative and quantitative. Qualitative testing is the easiest, and cheapest, but not the most scientific method. Essentially, it relies on the user detecting an odor, such as banana oil, released in close proximity to the respirator, and other means dependent upon the user's senses. Quantitative testing, the means used extensively by LASL, relies upon nonsubjective electronic means to obtain specific measurements. While superior from a scientific viewpoint, such equipment might cost $10,000 or more. This kind of investment may be justified for large users of respirators, but LASL instructors stressed that the qualitative methods are perfectly adequate and are the minimum acceptable for a respirator-fitting program.

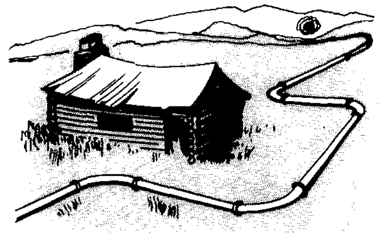
Other problems dealt with include fogging from cold (fogproofing sprays work well except in extreme temperatures), beards, sideburns, mustaches, and whiskers (a 2-day growth of whiskers on a usually clean-shaven face can affect performance), dental plates and bridges (abnormal pressures within masks can dislodge them), and communications. It is almost impossible to be heard while wearing a respirator. One effective device utilizes a transmitter-receiver placed in the ear where it does not interfere with the fit of the mask itself.

Afternoon sessions were, for the most part, devoted to letting the attendees put on various respirators, test them for leaks, and disassemble, inspect, and clean them. If the verbal and written instruction that preceded this "hands-on" event had not convinced participants that respirators were a complex subject, actually handling and breathing through them did.

Praise for the expertise of LASL instructors and the thoroughness of the curriculum was unanimous. A few participants offered constructive suggestions toward improving the presentation from a communications point of view, such as by letting pupils handle and become familiar with respirators at the beginning of the course. All agreed that the content was unique and embodied coherent information from one source available nowhere else.

As the interest in and need for respirators continue to grow, so will the need for information and training. Which is why Group H-5's "troupe" has been travelling about with LASL's unusual "Respirator Road Show."

10 years ago in los alamos



Culled from the January and February, 1966, files of The Atom and the Los Alamos Monitor by Robert Y. Porton

Saved by the Bell!

The old log cabin on Pajarito Road has been reprieved from doom. Not only that, it will be marked with a sign relating its origin and historical significance. The action was decreed by AEC Area Manager Charles Campbell in response to reports that a new hydrogen pipeline would require removal of the homestead cabin near the entrance to Ten Site. Campbell said the pipeline will be rerouted.

Appointment:

Harold Agnew, W-Division Leader, has been named Chairman of the Army Scientific Advisory Panel. He replaces Finn Larsen who has become Deputy Director of Defense for Research and Engineering. In his new post, Agnew is also an ex-officio member of the Defense Science Board, an advisory group of 28 scientific and industrial leaders that counsels the Secretary of Defense on the needs and opportunities presented by new scientific knowledge relating to weapons systems.

Ten Named AIC Fellows

Ten laboratory chemists have been elected Fellows of the American Institute of Chemists. The professional society confers Fellowships on "chemists or chemical engineers who have achieved full maturity in their professions as evidenced by their records of outstanding scientific accomplishments or by having attained positions of distinction or responsibility." LASL staff members honored are: Robert Fowler, Thomas Keenan, William Keller, Joseph Leary, Robert Mulford, Clayton Olsen, Sherman Rabideau, Leslie Redman, Louis Smith, and Glenn Waterbury.

Teachers Worried

The Los Alamos County Board of Educational Trustees was asked for guidance this week on student disciplinary problems by a delegation of teachers. The feeling of the board generally was that school discipline was a growing national problem indicative of the changing character of the country and that it couldn't be solved by board edict. High School Principal George Joyce said that about 2 per cent of the students take up 80 per cent of the High School administrators' time.

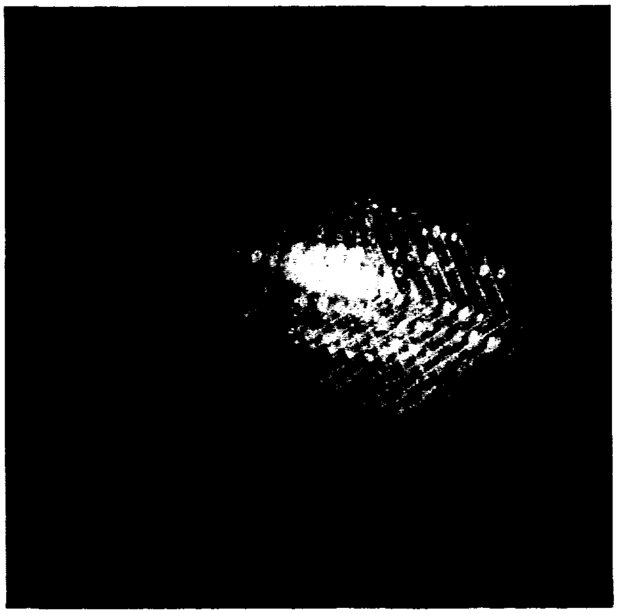
Among Our Guests

Visiting DP Site to review plutonium handling methods on January 12 was R. W. Roberts, ERDA Assistant Administrator for Nuclear Energy, and Don Vieth, assistant to Roberts. Left to right: Richard Taschek, associate director for research, Vieth, Roberts, Harold Agnew, Director, Sam McClanahan, and Richard Kent, both CMB-11.

Speaking at a LASL colloquium on December 2 was Nobel Laureate George Beadle of the Department of Biology, University of Chicago. His topic was "The Mystery of Maize." The study of corn provides important clues to the development of prehistoric cultures in the Western Hemisphere. Here Donald Petersen, alternate H-Division leader, looks at corn samples with Beadle.

William Bodo, (right), staff member of the ERDA-International Security Affairs Division, visited LASL on December 3 to inspect various weapons and energy programs, here chats with John C. Hopkins, J-Division leader, and Duncan MacDougall, associate director for weapons, during his tour.

On November 26, Major General Ranald Adams, USAF (right), and some 20 officers and civilians attached to the Kirtland Air Force Base visited LASL for briefings and tours. Below he makes a point with Herman Deinken, Group ADWP-1 associate leader, in the Brown Room.



Is this some vehicle from outer space? A wire contraption around a light source? It's neither, but rather is a model of a molecular crystal structure generated by computer for Group CNC-4.

However, it represents a great deal more than that. The printed page cannot convey its remarkable property of being not only 3-dimensional, but of presenting different perspectives from different viewing angles. For more on how it's done, see the article beginning on page 6.